QoS Configuration

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Chapter 1 QoS Configuration

If you care to use your bandwidth sufficiently and your network resources efficiently, you must pay attention to QoS configuration.

1.1 QoS Overview

1.1.1 QoS Concept

In general, OLT works in best-effort served mode in which OLT treats all flows equally and tries its best to deliver all flows. Thus if congestion occurs all flows have the same chance to be discarded. However in a real network different flows have different significances, and the QoS function of the OLT can provide different services to different flows based on their own significances, in which the important flows will receive a better service.

As to classify the importance of flows, there are two main ways on the current network:

1) The tag in the 802.1Q frame header has two bytes and 3 bits are used to present the priority of the packet. There are 8 priorities, among which 0 means the lowest priority and 7 means the highest priority.

2) The DSCP field in IP header of the IP packet uses the bottom 6 bits in the TOS domain of the IP header.

In real network application the edge device distributes different priorities to different flows based on their significance and then different services will be provided to different flows based on their priorities, which is the way to realize the terminal-to-terminal QoS.

Additionally, you can also configure a device in a network, enabling the device to process those packets with specific attributes (according to the MAC layer or the L3 information of packets) specially. This kind of behaviors are called as the one-leap behaviors.

The QoS function of OLT optimizes the usage of limited network bandwidth so that the entire performance of the network is greatly improved.

1.1.2 Terminal-To-Terminal QoS Model

The service model describes a group of terminal-to-terminal QoS abilities, that is, the abilities for a network to transmit specific network communication services from one terminal to another terminal. The QoS software supports two kinds of service models: Best-Effort service and Differentiated service.

1.2.1.1 Best-effort Service

The best-effort service is a singular service model. In this service model, an application can send any amount of data at any necessary time without application of permits or a forehand network notification. As to the best-effort service, if allowed, the network can transmit data without any guarantee of reliability, delay or throughput. The QoS of the OLT on which the best-effort service is realized is in nature this kind of service, that is, first come and first served (FCFS).

1.2.2.2 Differentiated Service

As to the differentiated service, if a special service is to be transmitted in a network, each packet

should be specified with a corresponding QoS tag. This designation can be embodied in different modes, such as, use IP priority status setting in IP data packet. The OLT uses this QoS rule to conduct classification and complete the intelligent queuing. OLT QoS provides strict priority (SP), Weighted Round Robin (WRR), and Weighted Fair Queuing (WFQ).

1.1.3 Queue Algorithm of QoS

Each queue algorithm is the important basis to realize QoS. The QoS of the OLT provides the following algorithms: Strict Priority (SP), Weighted Round Robin (WRR), Weighted Fair Queuing (WFQ) and First-Come-First-Served (FCFS).

1.1.3.1 Strict Priority

This algorithm means to first provide service to the flow with the highest priority and after the highest-priority flow comes the service for the next-to-highest flow. This algorithm provides a comparatively good service to those flows with relatively high priority, but its shortage is also explicit that the flows with low priority cannot get service and wait to die.

1.1.3.2 Weighted Round Robin

Weighted Round Robin (WRR) is an effective solution to the defect of Strict Priority (SP), in which the low-priority queues always die out. WRR is an algorithm that brings each priority queue a certain bandwidth and provides service to each priority queue according to the order from high priority to low priority. After the queue with highest priority has used up all its bandwidth, the system automatically provides service to those queues with next highest priority.

1.1.3.3 Weighted Fair Queuing

Weighted Fair Queuing (WFQ) classifies the packet according to the priority of the traffic. It sets the egress bandwidth based on the weight of each traffic. The bigger the weight, the greater the bandwidth. Thus, it guarantees the fairness of priority services and embodies the weight of different priority services.

1.1.3.4 First Come First Served

The First-Come-First-Served queue algorithm, which is shortened as FCFS, provides service to those packets according to their sequence of arriving at an OLT, and the packet that first arrives at the OLT will be served first.

1.2 QoS Configuration Task List

In general, OLT will try its best to deliver each packet and when congestion occurs all packets have the same chance to be discarded. However, in reality different packets have different importance and the comparatively important packets should get the comparatively good service. QoS is a mechanism to provide different priority services to packets with different importance, in which the network can have its better performance and be used efficiently.

1.3 QoS Configuration Tasks

1.3.1 Setting the Global CoS Priority Queue

The task to set the QoS priority queue is to map 8 CoS values, which are defined by IEEE802.1p, to the priority queues in an OLT. This series of OLT has 8 priority queues. According to different queues, the OLT will take different schedule policies to realize QoS.

In the global configuration mode, configure CoS priority queue may affect the cos priority queue mapping of all ports.

Enter the following privileged mode and run the following commands one by one to set CoS priority queue.

Command	Purpose
configure	Enters the global configuration mode.
[**no**] **cos map** *quid cos1..cosn*	Sets the CoS priority queue. Quid means the ID of a CoS priority queue. cos1…cosn means the IEEE802.1p-defined CoS value.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.2 Setting the Bandwidth of the CoS Priority Queue

The bandwidth of priority queue means the bandwidth distribution ratio of each priority queue, which is set when the schedule policy of the CoS priority queue is set to WRR. This series of OLT has 8 priority queues in total.

If this command is run, the bandwidth of all priority queues on all interfaces are affected. This command validates only when the queue schedule mode is set to WRR. This command decides the bandwidth weight value of the CoS priority queue when the WRR schedule policy is used.

Run the following commands one by one to set the bandwidth of the CoS priority queue.

Command	Purpose
configure	Enters the global configuration mode.
[**no**] **scheduler weight bandwidth** *weight1...weightn*	Sets the bandwidth of the CoS priority queue. weight1...weightn means the weights of 8CoSpriority queues of WRR/DRR.
Exit	Goes back to the EXEC mode.
Write	Saves the settings.

1.3.3 Setting the Schedule Policy of the CoS Priority Queue

An OLT has many output queues on each of its port. This series of OLT has 8 priority queues. The output queues can adopt the following four modes:

1) SP (Sheer Priority): In this algorithm, only when the high-priority queue is null can the packets in the low-priority queue be forwarded, and if there are packets in the high-priority queue these packets will be unconditionally forwarded.
2) WRR (Weighted Round Robin) is an algorithm that brings each priority queue a certain bandwidth and provides service to each priority queue according to the order from high priority to low priority.
3) WFQ (Weighted Fair Queuing) is an algorithm that brings each priority queue a certain bandwidth according to the priority of the flow.
4) FCFS (First come first served): The First-Come-First-Served queue algorithm, which is shortened as FCFS, provides service to those packets according to their sequence of arriving at an OLT, and the packet that first arrives at the OLT will be served first.

After this command is configured, the schedule mode of the interface is set to the designated value. Enter the following configuration mode and set the schedule policy of CoS priority queue.

Command	Purpose
configure	Enters the global configuration mode.
[**no**] **scheduler policy** { **sp** | **wrr | wfq | drr | fcfs** }	Sets the schedule policy of the CoS priority queue. sp means to use the SP schedule policy. wrr means to use the WRR schedule policy. wfq means to use the WFQR schedule policy. drr means to use the DRR schedule policy. fcfs means to use the FCFS schedule policy.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.4 Configuring the Minimum and Maximum Bandwidths of CoS Priority Queue

The minimum and maximum bandwidths of CoS priority queue can be modified through configuration. All the flows with a bandwidth less than the configured minimum bandwidth shall not be dropped, but the flows with a bandwidth bigger than the configured maximum bandwidth shall all be dropped.

Enter the privileged mode:

Command	Purpose
config	Enters the global configuration mode.
interface type slot/port	Enters the to-be-configured port.
[**no**] **cos bandwidth** *quid min-bandwidth max-bandwidth*	quid means the priority queue. min-bandwidth means the minimum bandwidth. max-bandwidth means the maximum bandwidth.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.5 Setting the Default CoS Value of a Port

If the port of an OLT receives a data frame without tag, the OLT will add a default CoS priority to it. Setting the default cos value of a port is to set the untagged default CoS value, which is received by the port, to a designated value.

Enter the PON port or uplink port and run the following commands to set the default CoS value of a port:

Command	Purpose

configure	Enters the global configuration mode.
interface type slot/port	Enters the to-be-configured port.
[**no**] **cos default** *cos*	Sets the CoS value of the received untagged frames. cos means the corresponding CoS value.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.6 Setting the CoS Priority Queue based on dscp

Based on the DSCP value, the COS queue is mapped again, the DSCP value is modified and the congestion bit is changed.

Enter the privilege mode and run the following commands to set the default CoS value of a port:

Command	Purpose
config	Enters the global configuration mode.
[**no**]**dscp map** *word* {**dscp** *dscp-value* | **cos** *cos-value* | **cng** *cng-bit* }	Word means the DSCP range table. Dscp-value means to set the mapped DSCP value. Cos-value means to set the mapped priority CoS. Cng-bit means the mapped congestion bit.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.7 Establishing the QoS Policy Mapping

Flow classification means to identify a class of packets with certain attributes by applying a certain regulation and take designated actions towards to these packets.

The IP access list and the MAC access list which are used to match up with the data flows cannot be more than 16 rules, or the configuration will fail. When the action in the regulation is permit, the regulation is used to differentiate the data flows; when the action in the regulation is deny, the regulation has no function.

You can establish a QoS policy according to the following procedure. During configuration, you can set all the parameters of the QoS policy, that is, description, classify and action, or one or two of them. In the following section you can also edit the policy.

Enter the global configuration mode and then run the following commands to establish a new QoS policy mapping.

Command	Purpose
Configure	Enters the global configuration mode.
[no]policy-map *name*	Enters the configuration mode of the QoS policy

	map. Name means the name of the policy.
description description-text	Sets the description of the QoS policy. description-text means the text to describe the policy.
classify {ip access-list-name **| dscp** dscp-value **| mac** mac-access-name **| vlan** vlan-id **| ivlan** vlan-id **|cos** cos **| icos** cos **| ethernet-type** type **| precedence** precedence-value **| dscp** dscp-value **| tos** tos-value **| diffserv** diffserv-value **| arp-request | arp-reply | any }**	Configures the matchup data flow of the QoS policy map; access-list-name means the name of the IP access list; dscp-value means the diffserv field in the packets; mac-access-name means the name of the MAC access list; vlan-id means the ID of VLAN; ivlan means matching the inner tag; cos means the matched CoS value; icos means to match the inner cos value; type means Ethernet type; precedence-value means IP packet priority field (tos bit 5-7); dscp-value means IP packet DSCP field (tos bit 2-7); tos-value means IP packet delay, throughput, reliability and cost field (tos bit 1-4); diffserv-value means the entire tos field of the IP packet 8 byte arp-request means the arp request packet; arp-reply means the arp reply packet; any means to match any data flow.
action{bandwidth max-band **| {cir** commit-band **bc** commit-burst-size **{pir** pir-band **be** peak-burst-size**} | [conform {forward | drop | dscp** dscp-value **| discardable {green | yellow | red} | copy-to-cpu} | exceed {forward | drop | dscp** dscp-value **| discardable {green | yellow | red} | copy-to-cpu} | violate {forward | drop | dscp** dscp-value **| discardable {green | yellow | red} |**	Configures the data flow policy of a QoS policy map max-band means the highest bandwidth allowably occupied by a data flow. cir means to configure the guaranteed rate of the flow; bc means to configure the guaranteed burst size; pir means to configure the peak value rate of the

copy-to-cpu}]} | cos cos-value **| drop | dscp** dscp-value **| precedence** precedence-value **| forward | icos** icos-value **| ivlan {add** ivlanid **|** ivlanid**} | mac** mac-addr **| monitor** session-value **| queue** queue-value **| redirect** interface-id **| stat-packet | stat-byte | vlanID { add** vlanid **|** vlanid **} | copy-to-cpu}**	flow; be means the burst size of the peak value; confirm means to configure the action taking when the flow smaller than cir-rate; exceed means to configure the action taking when the flow bigger than cir-rate but smaller than pir-rate; violate means to configure the action taking when the flow bigger than pir-rate; discardable means to configure the preferable discarded tag to be the flow tagged with green, tagged with yellow or tagged with red. cos-value means to set the CoS field of the matchup flow to cos-value. cos-value; icos-value means to configure the inner vlan tag cos field of the flow to be cos-value; dscp-value means to set the DSCP field of the matchup flow to dscp-value; precedence-value means to set the IP priority field of the matchup flow to precedence-value; vlan-id means to add or modify vlan id field of the matched flow to vlan-id; ivlan-id means to add or modify the memory vlan tag vlan id field of the matched flow to ivlan-id; mac-addr means to configure the destination mac of the packet to mac-addr; queue-value means to configure the priority queue of the packet to queue-value; interface-id means the egress port for matching up the flow; drop means to discard the configured packets; stat-packet means the package number of the matched flow calculated by OLT; stat-packet means the byte number of the matched flow calculated by OLT; monitor means to forward the data packet to the

	mirroring port; forward means the configured packet; queue-value means the queue number of the enqueue; copy-to-cpu means to forward the packet to CPU;
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.8 Setting the Description of the QoS Policy Mapping

Enter the policy configuration mode and run the following commands to set the description of a QoS policy mapping. This settings will replace the previous settings.

Command	Purpose
configure	Enters the global configuration mode.
[**no**]**policy-map** *name*	Enters the configuration mode of the QoS policy map. Name means the name of the policy.
description description-text	Sets the description of the QoS policy. description-text means the text to describe the policy.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.9 Applying QoS Policy

QoS policy can be applied to the global or a port. Meanwhile, multiple policies can be applied. The same policy can also be applied to multiple ports. On the same port, the priorities of the policies which are earlier applied than those of the policies which are later applied. If a packet is set to have two policies and the actions are contradicted, the actions of the firstly matched policies.

Enter the following global configuration mode or the interface configuration mode and run the following commands to apply the QoS policy.

Note:

ONU port does not support the application of the QoS policy. Refer to "ONU Management Configuration" for more details about QoS policy on ONU.

Command	Purpose
qos policy *name* { **ingress**|**egress**}	Apply QoS policy in the global mode or on the port Name means the name of QoS policy mapping. Ingress means to exert an influence on the ingress.

	Egress means to exert an influence on the egress.
no qos policy *name*	Cancel the application to QoS.

1.3.10 Displaying the QoS Policy Mapping Table

You can run the show command to display all or some designated QoS policy maps.

Run the following command to display the QoS policy mapping table.

Command	Purpose
show policy-map [*policy-map-name* | **interface** *interface-id*]	Displays all or some designated QoS policy maps. policy-map-name means the name of QoS mapping table. interface-id means the designated interface.

1.4 QoS Configuration Example

1.4.1 Example for Applying the QoS Policy on a Port

The following example shows how to set packet's CoS to 2.

```
ip access-list extended ipacl
permit ip 192.168.20.2 255.255.255.255 192.168.20.210 255.255.255.255
policy-map pmap
classify ip ipacl
action cos 2
interface GigaEthernet0/2
qos policy pmap ingress
```